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ABSTRACT

One of the most interesting challenges facing educators today is how to engage students in meaningful study of the environment in which they live. This paper presents the benefits of studying scientific data from an aesthetic point of view. The visual display of the earth's surface through aerial photographs and satellite map images was used as the basis for interpretive art works created with dyed silk by high school students at the Pennsylvania Governor's School for Agricultural Sciences. Three main criteria were used to evaluate the final pieces: (1) use of color, (2) design (composition), and (3) approach (meaning). Final evaluations of the course suggested that it was a very satisfying experience for the students. Some of the outcomes gained through the exploration of mapping included: the development of visual literacy skills, including an ability to read symbols and layer information; an increase in knowledge pertaining to the origins and use of remote sensing data; and continued development of an aesthetic eye in the creation of unique works of art. (AEF)

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Mapping The World Through Science And Art

by Lydia Dambekalns

Abstract

One of the most interesting challenges facing educators today is how to engage students in meaningful study of the environment in which they live. This paper presents the rewards of studying scientific data from an aesthetic point of view. The visual display of the earth's surface through aerial photographs and satellite map images becomes the basis for interpretive art works created with dyed silk by high school students at the Pennsylvania Governor's School for Agricultural Sciences. Included in discussion are the pedagogy and practice of visual literacy skills and interdisciplinary ties between art and science.

Introduction

For years I have noticed the beautiful images of earth generated by Geographic Information Systems (GIS) remote sensing studies They have appealed to me for a number of reasons: from an artistic standpoint based on their colorful designs, from a cultural standpoint derived from the complexity they show of our life on earth, and from a scientific standpoint as an interesting source of data on world ecology. As an artist, I wondered how I might use them in my own studio work, and as an educator I began to think of opportunities to introduce students to these images.

In 1995, I saw an exhibit of work by Mary Edna Fraser in Washington, DC at the Smithsonian's National Air and Space Museum. An amazing array of huge banners hung from the ceiling in one large gallery depicting Fraser's artistic interpretations of land forms based on her piloted flights over the East Coast. These large maps of waterways, ridge and valley provinces, and coastal areas were inspired by aerial photographs taken by Fraser herself combined with remote sensing images from areas she could not reach. One of the most exciting aspects of the exhibit was its existence as an aesthetic representation of artistic endeavor in the midst of a traditionally science-oriented museum. Thus, directly in the public's gaze was an example of interdisciplinary connection between science and art. My own background as a fiber artist helped me to see the potential of using these map images on a smaller scale, possibly in an educational setting. But where?

The opportunity to work with maps in an artistic venue came my way a year later when I became associated with the Pennsylvania Governor's School for Agricultural Sciences (PGSAS) located on the campus of Penn State University. Every summer sixty-four outstanding high school scholars are selected for six intensive weeks of primarily science oriented curricula. However, the director of the program was particularly interested in presenting these students with a full compendium of challenging experiences. Part of that involved using visual/spatial intelligence (Gardner, 1993). As such, I developed an elective offering for those students based on using GIS and map imagery to create aesthetic representations of the earth.

The pedagogy behind the artistic production of these images is particularly interesting. In this paper, the PGSAS classroom example serves as one model of possible application. Unfortunately, due to lack of color reproduction in this publication, images of the final art pieces created are not shown. However, the problem set before the artist is discussed along with the background rationale for visual challenges and how the resulting works emerged. Although the technical procedures for working with the dye and cloth were important in this experience, it is not the focus here since concepts relating to visual literacy take precedence in this instance.

Background and Rationale

Despite efforts by some to separate the two, art and science may present similar challenges for study. Science attempts to solve problems and explain events in the universe as a way to reveal and/or gain knowledge about the physical world. While art may also be used to investigate the physical world, it also serves to express an individual's thoughts and feelings about the world and one's own reality. In other words, art may be partially defined as an

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aesthetic representation of an individual's view of the universe. In either case, both the scientist and artist rely on keen observation skills and an ability to work creatively. This notion underpins how a person looks at data and interprets that into understandable form. For the scientist/geographer this means mapping the earth's surface. For the artist in this case it means celebrating the diversity of our planet through visual depiction of the earth's characteristics.

Rudolph Arnheim, Professor Emeritus of the Psychology of Art at Harvard wrote in *Visual Thinking* (1969) that

> [it would be misleading to] pretend that in science the senses serve only to record data in the manner of a photographic camera and that the processing of the data is left to later and perhaps non-sensory operations. We find instead that direct observation, far from being a mere ragpicker, is an exploration by the form-seeking and form-imposing mind, which needs to understand but cannot unless it casts what it sees into manageable models." (Arnheim, 1969. p. 278)

Arnheim continues by explaining that central to understanding the shape of existence in both art and science is "an unselfish dedication to what is. Neither of them can tolerate capricious subjectivity because both are subject to their criteria of truth" (p. 300). In our post-modern era of constructivist thought we might tend to challenge Arnheim on the use of "truth" here. Nonetheless, the point stands that both science and art require disciplined inquiry and possess an order to that inquiry. And in the case of studying map data, how might this be used to form a visual problem for the artist to solve? Arnheim's attempt to dispel the dichotomy between perceiving and thinking serves as a basis for combining sensory information with theoretical ideas. The provision of a "unitary cognitive process" can lead the learner to analysis or abstraction of the visual image (Arnheim, 1969). And so to communicate this to the students/artists.

Statement of the Problem

In the particular case of the PGSAS students, I was faced with a primarily science-oriented population who held varying degrees of confidence in their artistic capabilities. The immediate problem was simple enough: how to use data gathered through GIS images as a launch for interpretive visual images of place, be it local or global. Beyond that, students' final pieces would have to exhibit consideration of a number of visual challenges including perspective, scale, attention to hue and value, emphasis, abstraction, simplification and layering. To make this clearer for the students, I consolidated these concerns under three larger umbrellas: a) use of color, b) design (composition) and c) approach (meaning). These would be our criteria in evaluating the final pieces.

Application/Approach

Any complex visual problem involves the synthesis of a number of components. For the PGSAS students this meant combining basic knowledge, technical skills, and unique perspectives to create their art works. First, students needed to have some comprehension of how the original images were created. The two main categories for most of these maps were divided into use of digital images versus a photographic film system. The earth's surface may be recorded through infrared photography, through "false color" images, or through more naturalistic hues (as the unaided eye might see). The selection of a mode by geographers and scientists depends upon the purpose of the data collection, whether for urban planning, environmental monitoring, national defense, agricultural land use, or weather patterns (Smithsonian, 1992).

As a group, the PGSAS students visited the GIS labs at Penn State where map specialists explained how GIS information is applied in agricultural studies. From the collected images of the earth, a variety of maps in diverse pictoral styles present data in a clear and informative manner. Examples at Penn State included land use in the Allegheny Forest, a breeding birds atlas, non-point source pollution, population centers, soil types, livestock concentrations, groundwater patterns, and land use (cultivated, grasslands, evergreen or deciduous woods) among others.

The process of moving from digital images or photographs of the earth to a meaning-constructed map presents an interesting progression of stimuli for the artist. I wanted students to view their map

interpretation experience more as a visual challenge than as an isolated activity taken out of context.

Nicholas Roukes has written two books, *Art Synectics* (1982), and *Design Synectics* (1988) that are useful in suggesting guidelines for creative dilemmas. Through analogical thinking Roukes (1988) outlines three basic "R's" in the creative process: "Referring" where the thinker poses the problem and sets the goals, "Reflecting" where ideas are incubated, paths followed, abandoned, etc. and "Reconstructing" which is the process of re-inventing or transforming. These three gerunds summarize well the process necessary to transform the map images to art work. If thoughtfully undertaken, the product becomes more metaphorical and more sophisticated as a result of such problem solving.

Generally, the most successful artistic examples are the product of studied consideration. In the case of these maps, challenges for the Governor's School students included perspective, composition, color selection and use, scale, abstraction, simplification, emphasis, layering, and discrimination, all aimed at obtaining a meaning or ordering for the final image. The limited amount of time allowed in the PGSAS schedule prevented us from going into too much depth for each of these, but as a group students discussed how these visual concepts could be used in their own works. For instance, we reviewed the color wheel for some basic principles of color theory--how vibrancy results from juxtaposing contrasting colors or how neutrals may be made from mix of complementaries.

As a group, students learned about the technical aspects of how to handle fiber reactive dyes which do not react like paint, and how to treat silk as a ground for image-making. Each student practiced color mixing on paper, prepared one sampler to learn about the interaction of dyes and silk, and sketched out their final design on a large piece of prepared silk. All students produced at least one large final image either in a square or rectangular format. Some chose to design two un-related pieces and some created two complementary pieces which acted as a diptych when displayed side by side.

The actual fabrication of the work took several days during which time students had the opportunity to interact with each other and refine their own ideas as the works progressed, a clear demonstration of Roukes' three "R's" in practice. On the final day, we held a group critique and examined how each person had chosen to solve the visual challenge I had posed. In many cases, we found problems students had created and overcome for themselves.

Results

The artistic map images in the end were stunning. Students demonstrated a wide range of solutions to each of those issues (perspective, use of color, abstraction, emphasis, etc.) discussed at the beginning. Perspectives in the final pieces ranged from a vastly distant viewpoint to flat up-close interpretations of the earth's surface. A few artists chose to tip their work to reflect the three-quarter interpretation one might find while flying over the earth in an airplane. Color use varied from monochromatic to multi-hue, from natural earthtones to electric vibrancy. Design schema incorporated a range of shapes from the exquisitely simple yet elegant to splotchy aeoemba-like amorphous complexity.

Some overall interpretations of the map data were very abstract while others literally portrayed the earth forms as the original image had shown. The aesthetics of images also varied. For example, one student created two pieces both portraying the earth from outer space. In one, the earth appeared relatively insignificant as it sat suspended in the gentle grip of two dark arms. In the other, an almost sinister-like atmosphere of half-human half-planetary faces surrounded our familiar swirling blue and green planet. Some final art pieces suggested a docile earth of meandering waterways, pastel colors, and balanced nature while others depicted Mankind's hand upon the land and how that has changed the natural scheme of things.

Conclusions

Final evaluations of the course suggested that it was a very satisfying experience. The products were powerful visual statements, but more importantly, through the process the students began to gain confidence in their ability to use data beyond a scientific literalism. They were able to make connections in the way artists and scientists think alike and how the processes differ. And for many, ran the unifying theme of

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wonder and reverence for the diversity of geological form and biological mass on this planet.

The focus of this project as presented in this paper involves visual literacy in art and science. However, the concept of viewing the earth in all its diversity lends itself well to an even larger interdisciplinary framework. In his book *Ecological Literacy*, David Orr writes about how our world view may encourage a sustainable lifestyle through modest use of the planet's resources. In his discussion of place and pedagogy, Orr calls for the integration of place into education and the "dialogue between a man and a place" or "the art of living well in a place" (Orr, 1992, p. 126). As educators, we can find a way to integrate the concept of valuing earth and our "place" into our curriculum by integrating knowledge from the disciplines with ethical and philosophical considerations.

The type of visual inquiry reflected in this paper and applied at the Pennsylvania Governor's School for Agricultural Sciences holds just such a potential. By integrating several disciplines and allowing students to pursue a theme related to the earth's diversity and natural resources, students gain a sense of interconnectedness between art and science, ecology and aesthetics. In summary, some of the outcomes gained through the exploration of mapping as described in this paper include 1) the development of visual literacy skills including an ability to read symbols and layer information, 2) an increase in knowledge pertaining to the origins and use of remote sensing data, and 3) continued development of an aesthetic eye in the creation of unique works of art. Hopefully, this project acts as a catalyst for further explorations into the disciplines.

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